

RALPH ABRAHAM

AND THE

FOUNDATIONS

OF CHAOS

The strata of Western cosmogonic myths have been built up out of layer upon sedimentary layer of peoples, races and tongues which the ebb and flow of time has fossilized into the broken torsos and fallen colossi which crowd our historical landscapes. A random sample taken from this deposit — like a cross-section from a slab of Cambrian shale — reveals to us at least two quite distinct species of genesis narrative. The Babylonian epic, *Enuma Elish*, is a specimen of the first kind. The core of its narrative describes how the solar god Marduk confronts Tiamat — the goddess of the watery abyss — and like a Paleolithic hunter closing in on his prey, captures her with a net and shoots an arrow into her belly. Then he slices her in half to create a sort of cosmic dwelling out of her body; for just as the mammoth hunters built houses out of the interlocking bones of their prey in order to signify that the animal *was* the cosmos within which they lived, so the ancient Leviathanic skeleton of Tiamat becomes the cosmic frame of the habitation within which the gods dwell. We find a similar account in *Genesis 1*, where Tiamat reappears transformed as *tehom*, the watery abyss out of which Yahweh separates the firmament above from the firmament below. And in Plato's *Timaeus*, the Demiurge confers order on the disordered realm of the four elements by hammering the world into being from out of their substance.

The best example of the other species of myth has been preserved for us

in Hesiod's *Theogony*. For it is there that Chaos, the yawning void, spontaneously generates an ordered cosmos of deities, the firstborn of which is the goddess Gaia, the seedbed from which her husband, the sky god Ouranos, grows like a plant. Examples of this self-generation of the cosmos survive even in pre-Socratic philosophies of the origins of the world. In Anaximander, for instance, the Infinite spins the world into being by an eternal motion which has the effect of separating out the pairs of opposites hot and cold, wet and dry. And in Anaxagoras, this undifferentiated substance containing the seeds of all things is whirled into being by an immanent Mind that sets it in motion. Even in the atomist philosophy of Democritus there is an echo of this myth as the primordial motion of the atoms knock against each other until a vortex forms and begins the process of creation.

Myths of self-generation are, of course, older than those of the first kind, based upon the organic paradigm of a plant growing with spiral motion from out of its mother soil: these myths stem ultimately from the Neolithic Age, with its worship of the goddess earth as a self-generating matrix of creativity. Those of the first kind, however, are based upon the idea of a cosmic architect who creates the universe through an act of renovation by destroying the old foundations and building anew. They are consequently of a masculine nature, rooted in the Indo-Aryan paradigm of the warrior and his blacksmith-magician. These myths have been the foundation of most Western cosmogonies for the past four thousand years.

However, it has been the particular emphasis of the work of chaos theoretician Ralph Abraham to demonstrate that the earlier mythologies in which chaos was the self-generating vortex which gave rise to the universe is returning under the guise of a branch of mathematics known as dynamical systems theory, which is based upon the creation of mathematical models of dynamical processes in nature. In dynamical systems theory, chaos is no longer regarded as "noise" to be purged from mathematics in order to maximize Platonic purity. The fractal contours and rough edges of nature are the earth goddess herself who, in the guise of storms, flowing rivers, beating hearts and jagged shorelines, has begun to enter the traditionally masculine domain of mathematics.

Chaos theory deals with the processes of the world of nature not in any

ideal sense but in a very concrete way. Through the aid of computer graphics, it has been discovered that when systems enter states of turbulence — boiling water, epileptic seizures, mob riots — they are in fact entering into states of organization so infinitely complex that they only appear to the unaided eye to be disordered. In fact, they are states of semi-random activity governed by a mathematical geometry known as a chaotic attractor, which configures the apparent chaos into states of complex order. In the words of William Blake, "I was walking among the fires of hell, delighted with the enjoyments of Genius; which to Angels look like torment and insanity."

Ralph Abraham's fascination with these self-organizing properties of chaos has provided him with the central vector guiding his career as a mathematician and philosopher. In the late sixties while Abraham was teaching mathematics in Princeton, the eclectic scholar of history Immanuel Velikovsky happened to be giving informal lectures to a group of students on the stability of the solar system. Velikovsky had published a most sensational book in 1950, entitled *Worlds in Collision*, in which he articulated the unpopular view that a comet had nearly collided with the earth in 1500 B.C.E., and that its passage not only caused hurricanes, floods, and earthquakes, but tilted the earth off its axis, reversed its rotation, and brought an end to the civilizations of Minoan Crete, Dravidian India, and Middle Kingdom Egypt. Furthermore, Velikovsky went on to assert that the comet had in fact split off from Jupiter and later became the planet Venus, which nearly collided with Mars in the eighth century and then again in the seventh, before stabilizing into its present orbit.

Velikovsky's apocalyptic images, needless to say, earned him a scientific crucifixion, although fellow Princeton resident Albert Einstein found his work fascinating. It was while Abraham was teaching at Princeton that a group of students approached him in regard to Velikovsky's ideas, and Abraham found himself thinking considerably enough about the problem to write his first book, *The Foundations of Mechanics*. Then, in 1972, Abraham migrated to Paris, where he studied with mathematician Rene Thom, whose book *Structural Stability and Morphogenesis* laid the groundwork for a discipline of mathematics called catastrophe theory. Despite its name, catastrophe theory actually focuses on stability in dynamical processes,

whereas chaos theory, developing simultaneously in America, emphasizes states of turbulence.

Abraham, meanwhile, had been experimenting with LSD since his first ingestion of it in 1967, which catalyzed a series of visions of radiant mathematical topologies which he later termed “dynamatons.” A chance encounter with Ram Dass in a cafe in Amsterdam directed him to a guru in India, where Abraham spent a period of several weeks ingesting LSD, studying Hindu philosophy and practicing yoga. It was during this journey to “the Magic Mountain” that Abraham’s various interests began to resonate as a single field of ideas based upon “vibration” research. Proficient in mathematics since childhood, he recognized that the drug-induced visions of luminous dynamatons were similar to the mathematical objects he had been studying in dynamical systems theory, and he recognized that the Hindu vision of the world as a giant series of interlocking waves could provide a larger cosmological paradigm with which to frame his studies. When he returned to California in 1974, he distilled these ideas in a paper which he published the following year, entitled “Vibrations and the Realization of Form.” At this time, he was also teaching his theory of vibration research at the University of California at Santa Cruz.

In 1980, he began a four-volume textbook on dynamical systems theory co-authored with Christopher Shaw, called *Dynamics: the Geometry of Behavior*, an eight-year project. The book signals an epoch in the history of mathematics, for it contains not a single equation. It is perhaps part of a larger shift in our culture which Marshall McLuhan was the first to identify as that from the linguistic structures of the left brain to the iconic orientation of the right brain, supported by the post-war rise of electronic technology. In the same year, his conversations with friends Terence McKenna and Rupert Sheldrake were published as *Dialogues at the Edge of the West*. A sequel to this volume entitled *The Evolutionary Mind: Dialogues at the Edge of the Unthinkable* was published in 1998.

In 1994, Abraham’s book *Chaos, Gaia, Eros: A Chaos Pioneer Uncovers the Three Great Streams of History* was published. The book explores the historical transformations of myth and science, particularly insofar as the goddess of chaos has been regarded throughout history. Its contents form the axis of the discussion which follows. In 1995, Abraham co-authored *The*

Web Empowerment Book with Frank Jas and Willard Russell. He is currently working on a series of volumes which he terms "The Euclid Project," that traces the roots of Euclidean geometry and the interface of Euclid with chaos theory. He is also co-authoring a book with William Irwin Thompson tentatively entitled *Bolts Out of the Blue: Art, Mathematics and the Evolution of Consciousness*.

JE: You mention in your book Chaos, Gaia, Eros that when you were teaching in Princeton in 1966 on the stability of the solar system, a group of students who were interested in Immanuel Velikovsky's comet theories came up to you and asked whether it was possible that the earth could be knocked off its course by the impact of a comet, and that this was what inspired the direction of your first book The Foundations of Mechanics. I was wondering if you wouldn't mind talking a bit about the relationship between Newton and William Whiston regarding the stability of the solar system.'

RA: Well, Whiston was attracted to Newton's mathematics and Newton was attracted to Whiston for his book about the origin of the earth and the solar system. Of course, Whiston's main theme was this comet theory, which is an interesting thread going back to Giordano Bruno, who also had a comet theory. Descartes had a vortex theory. All these theories were similar kinds of heresy in their time, but now, of course, make a lot more sense — for example, in relation to the Couette-Taylor stirring experiment, in which it is shown that vortices create form. They are the main mechanisms for form to emerge out of fluid.

So anyway, the comet theory, in the time of Whiston and Newton, was regarded as an exegetical thesis on the *Old Testament*. Whiston and Newton were very serious Christians and believers in the *Old* and *New Testaments*, and interpreted particularly *Genesis*, line by line. There had to be a concordance between classical science as it was emerging in their time — and that was the great creative moment for classical science — and the *Old Testament*. So in Whiston's book, the comet theory entered as a creation myth interpolated between the first two verses of *Genesis*: there might have been a big bang and then a fluid dynamical spinning universe in which vortices developed and coalesced into comets and galaxies. Hence, the

earth.² Now I think that both Whiston and Newton agreed that the solar system was unstable and required periodic interventions by God in order to keep it on track. So they did not believe that the equations of motion according to Newton had solutions that corresponded exactly to the motion of the solar system.

JE: And of course, Immanuel Velikovsky picked up this old comet heresy for his book Worlds in Collision in 1950.

RA: Yes, that book is also about this comet theory, in which various paradoxical statements in traditional histories like the *Old Testament* and in the myths of various countries were interpreted as being true accounts of celestial catastrophes by Velikovsky. That was his idea.

JE: Did his comet theories have anything to do with those that were proposed for the extinction of the dinosaurs?

RA: I'm not sure that Velikovsky touched on that. I think it would have had a negative impact, if any, in that if this theory had been associated with Velikovsky's name, then orthodox scientists would have been more loathe to propose it when they did, although it was controversial. All these things have been controversial upon the moment of their introduction. For example, the theory of continental drift was a very difficult theory for scientists to accept, and that controversy has been studied in great detail in a historical book.

Velikovsky was rather beyond being a scientific heretic in that he particularly attacked the *stability dogma*. If science said the solar system was stable and then Velikovsky said it wasn't, then Velikovsky would be a heretic. But science didn't say the solar system was stable; scientists *thought* that science said that. They hadn't really thought about it. They didn't know, it was just a belief. And Velikovsky attacks their belief as opposed to science itself. As far as the science is concerned, as people understand it today, Velikovsky was *not* heretical. He agreed with the actual understanding of Newton, Laplace and modern astronomers that the solar system is as a matter of fact not stable, it's chaotic. So, it's a heresy in the context of dogma and not a heresy in the context of theory.

That's what really took my attention in 1966 when these students came

to me from Velikovsky's living room: from what I heard there was no heretical content. By 1966 Velikovsky had been vindicated by Kolmogorov, Arnold and Moser, the great mathematicians of solar system dynamics, but the astronomers didn't know that. The word wasn't really out until 1970 or so, in the astronomical community. So I could see that this was just dogma at work. And they had attacked him most viciously. *Worlds in Collision* had been attacked even before it was published. There was an unsuccessful attempt of orthodox astronomers of Harvard University and so on to suppress it, by contacting the publisher and insisting that it should not be published.

There was a similar situation in the case of Giordano Bruno, who, when he was led to a pile of firewood on Easter Sunday in the year 1600 was given one last chance to recant his main position, that the universe was infinite. If it was infinite then there was no place for God to reside. So the picture of the universe held by the Pope in 1600 was that the stars occupied a two-dimensional universe: the celestial sphere, inside of which the planets moved and outside of which there was an empty space that was God's domain. There couldn't be any evidence at that time that the universe was two-dimensional or three-dimensional. You couldn't really tell. Telescopes hadn't been used to observe the parallax and establish that the stars were in a 3-D continuum. So it was just dogma. Bruno was offered this deal, a chance to recant his views, as 100,000 people assembled to watch his immolation, and he said, "I don't think I should say that, so I won't," and they burned him.

JE: And Bruno had helped to revive the Hermetic tradition by attempting to carry it on into the scientific mainstream?

RA: Well, he was giving public lectures to groups of interested people in which he participated in the Hermetic revival of the Renaissance. One of the main themes of the Renaissance was the discovery of this literature of late antiquity, *The Chaldean Oracles* and *The Corpus Hermeticum*. These were regarded as so important that when Cosimo de Medici founded the Platonic Academy in Florence in the 1440s he ordered its new director Marsilio Ficino to translate *The Corpus Hermeticum* before beginning on the Platonic corpus.

JE: And these writings had come from Alexandria?

RA: Yes, in the second century C.E. That's what's now believed. But in the time of Cosimo de Medici and Marsilio Ficino it was believed that they were much older and that they derived from the tradition called the *prisci theologi*, the old masters, including both Moses and Hermes. Hermes himself was thought to have written *The Corpus Hermeticum* around 2000 B.C.E. or so. That's why it would precede Plato.³

JE: What does this tradition have to do specifically with what you term in your book the Orphic tradition?

RA: Well, *The Corpus Hermeticum*, although written down in 200 C.E. in Alexandria does truly represent an ancient tradition, and I am suggesting that this Hermetic tradition, as it's called — especially since its revival in the Renaissance — is a remnant of the Goddess partnership society which preceded the patriarchal takeover in 4000 B.C.E. The patriarchal takeover began a process of the suppression of that literature, which became more and more complete as the years went on, and after the arrival of Christianity, was eventually almost totally buried, and along with it the Platonic corpus. So the rediscovery in the Renaissance of the Platonic corpus and the Hermetic corpus essentially revived the oral literature of this pre-patriarchal society.

Now in order to understand that this theory makes sense you have to read *The Corpus Hermeticum*. What's it about? And the main idea, I would say, is what we would call a kind of esoteric astrology, or star magic, in which there were influences on earth emanating from the stars and not just from their positions radiated through the gravitational field, but actually a spiritual emanation. So this is one of those emanation theories which have existed in all times and places and cultures. The emanation theory gave rise eventually to optics and therefore to experimental physics in the Middle Ages and to science as we know it today. Alchemy and astrology are remnants of the Hermetic tradition going back to pre-patriarchal times, and therefore part of what I call loosely, the Orphic tradition. The literature and mythology of this peaceful society spanned the entire globe for a long time, so it was a very deeply rooted tradition.

JE: And you see Newton as one of the last bearers of this tradition within the scientific mainstream?

RA: Well, we'd have to regard Newton himself as a kind of hinge person. He was on the cusp. Some people describe him as the last of the Hermetic philosophers because until his death he practiced alchemy on a daily basis with his own furnace.⁴ So he was truly a scholar of the Hermetic tradition. But the theory that he gave the world, which is sometimes described as the greatest intellectual contribution ever made by a single person, was very quickly pressed into the service of the law and order mentality of modern science and the so-called Enlightenment.

JE: So if we may shift, then, to Poincaré, who's generally credited with being the father of chaos theory, what role did he play in all of this?

RA: Well, he's the father of chaos due to the discoveries that he made while striving to earn the prize of Oscar II of Sweden, which was offered to anyone who could prove that the solar system was stable. It was thought possible to do so because Dirichlet on his deathbed said that he could prove the stability of the solar system using Newton's equations, but like Fermat's Last Theorem, it wasn't written down, and then he died.

So the efforts of mathematicians struggling to supply this missing proof and being unable to do so created a kind of Mount Everest in pure mathematics at that time, which was fueled by popular interest in the stability of the solar system. This goes back to these early spiritual roots where the original tradition said that the stability of the world was provided by emanations from the stars associated with gods and goddesses. In pagan belief, the stability of appearances was maintained by the *anima mundi*, the spirit of the world, particularly through its various manifestations as gods and goddesses, semi-gods and semi-goddesses, including stars and constellations of stars associated with names of mythological characters that participated in celestial dramas like soap operas in the sky.

Poincaré, then, set out to prove the stability of the solar system, but ended up by actually establishing the inability of Laplace's analytical method to do this. He won Oscar's prize, anyway, and went on to invent new mathematical systems which resulted in the discovery of chaos in the solar system.

JE: Wasn't it true that Newton's theory of universal gravitation originally met with a certain amount of resistance because it reminded

people of these emanations from the stars and these nonmaterial forces connecting everything?

RA: Yeah, it still does. I think that the problem of understanding the gravitational field is not yet solved. Einstein gave us a big advance there by saying that the gravitational field is simply the geometry of the underlying space-time continuum of the universe. But that still kind of begs the question because, when you put a large object like a quasar out there, and then the geometry of space all over the entire universe is suddenly changed by the appearance of that mass, how could that be? We have a mathematical model here; the Einstein equations there; and numerical solutions by computer showing exactly what this would look like. But there's no intuitive model. It's still action at a distance. We could, in other words, regard Newton's theory of universal gravitation and Einstein's model for the cosmos simply as modern representations of the old emanation theory.

JE: Now in your book Chaos, Gaia, Eros, you say that chaos theory retrieves this stream of the Orphic-Hermetic tradition. How does it do this?

RA: Well, it's one of the main themes of my book, concerning the importance of the chaos concept in the entire span of cultural history. I'm identifying the Orphic tradition with an outgrowth from its roots in pagan society, especially before the patriarchal takeover. That society was characterized by a distinguished role for chaos as a goddess of creativity, so that throughout that time you have the image of the goddess in association with snakes and vortices and water and chaos.⁵ After the arrival of the patriarchy, however, then the chaos concept — personified for example as Tiamat in the *Enuma Elish* — is replaced by the god of order, which represents the key to understanding patriarchy — this obsession with order.

Then the chaos revolution comes along and as I say, puts Tiamat back on her throne, reestablishes the importance, the validity, the beneficence of chaos in life as well as in science, in the solar system, in the biosphere and so on. Therefore, it gives new life to the lost goddess tradition along with its chaos concept, with its emanation theory, with its idea of the maintenance of ordinary reality through something more or less supernatural or

paranormal. All of that is suddenly restored and revived by the chaos revolution of these past twenty, thirty years.⁶

JE: So chaos theory also in some way rescues catastrophe theory from its place as a scientific heresy as well?

RA: Yes, catastrophe theory was kind of a harbinger of chaos theory. It's kind of a special case of chaos theory, and it was the intellectual product of Rene Thom, who was one of the great pioneers in chaos theory after Poincaré. It's the one little tiny branch on this big tree which happened to make it to the front page of magazines and newspapers. It's the first breaking of the waters as a coming into popular consciousness and it was specifically this popularity and the attraction of public view, I believe, which led mathematicians to attack and kill catastrophe theory just a few years later.

JE: Could you say something then about attractors, basins and bifurcations?

RA: This is the main paradigm that mathematics provides you for all dynamical processes in the sciences. Bifurcation is a loose term denoting a special kind of change in the map of the dynamical behavior of a complex system. By the map, I mean the configuration of the attractors and the basins. In each basin, there is one attractor somewhere down in the center, some diffuse thing like a galaxy of stars: that's the attractor. In between the basins there are boundaries which separate one basin from another. And in this map, the attractors are diffuse and complex fractals, so that when you look at them in the microscope you see a recursive representation that looks the same as the unmagnified view.

Now when the underlying rule of the dynamical system is changed for some reason, for example, by the increase of an external force or temperature or the wind pressure or whatever, then the map changes and sometimes it changes in an insignificant way and sometimes it does a sort of snap and settles into a recognizably different map. That's a bifurcation. It's when the dynamical system is changed by external forces and something significant happens. Bifurcations generally are classified into three different sorts, called catastrophic, subtle and explosive bifurcations. The catastrophic bifurcations are also known by the pop name "catastrophes."

All of this picture — how it can be applied in the sciences, and why it's important — is a way of thinking which is now called dynamical literacy. And the way of thinking is more important than the mathematical theory or the specific models in which it's applied, as for example, fluid dynamical turbulence, or the origin of the universe or whatever. Rene Thom popularized this way of thinking in the special case of chaos theory called catastrophe theory. He made it understandable. He drew into dynamical literacy people from every branch of the sciences through his writings and exemplary applications to biology, linguistics, the social sciences, and so on.

*JE: And his book is Structural Stability and Morphogenesis?*⁷

RA: That's right.

JE: Now in your book you introduce a concept called "dynamical historiography," where you create this model of history based on these phase changes with three different kinds of attractors. Can you explain that?

RA: This is based on an idea of Thom or perhaps Christopher Zeeman, his main popularizer. The idea has to do with relating the history of mathematics to cultural history. As a culture evolves, through the practice of what they already know, people become more and more prepared to know more. So there is eventually a critical moment in which a new idea can come into the group mind of the culture because the culture has in its evolution arrived at the first moment in which it is capable of having that idea. In primitive times people would be unable to conceive such a thing as the cusp catastrophe. It wouldn't even fit into the mind because the connectivity of the neural net was too simple to envision such a complex mathematical object.

I have expanded this idea into what I call dynamical historiography in my book *Chaos, Gaia, Eros*, and also in various articles published earlier, in the last decade or so. I particularly applied this idea that certain mathematical objects come into the mind of a culture as soon as they can. I apply this idea to these three basic attractors of chaos theory: the static attractor — which is just an isolated point, obviously much simpler than a circle — came into the culture through fixation of nature in the form of gardens during the agricultural revolution; and the circular attractor, in

which a sequence of states is repeated over and over again, each cycle being completed in exactly the same span of time, hence periodic attractor, came in when the wheel was discovered 6000 years ago, as a toy wheel, then a pottery wheel, and then a cart wheel, and a model for the zodiacal belt and the solar system and the paths followed by the planets. All of this occurred suddenly in the period of 3500-4000 B.C.E. This is a much more complicated idea than a point attractor and yet it doesn't seem too complicated to us because we've had circles in our culture for 6000 years.

And now we're in a similar phase change, or paradigm shift, as Thomas Kuhn would say, with the chaotic attractor having just appeared. During my lifetime, I saw the complete process through which the chaotic attractor passed through a period of transition from heretical idea to orthodox science. This occurred during the span of my professional career. I personally experienced it in the context of my relationships with many different friends. I could feel the essence of it and I could imagine therefore very vividly how this paradigm shift happened. So that's my idea of dynamical historiography. These transformations happened on two sides, on one side as a mathematical model and on the other as a cultural manifestation that swung history on its axis.

JE: You often mention in your writings the work of William Irwin Thompson who also sees a series of these phase changes throughout history. Would you say that your theories are isomorphic for the most part with Thompson's?

RA: Yes. In one of his earlier works, *Pacific Shift*, he had already presented a model of cultural history in four phases which he traced back to ancient Mesopotamia.⁸ So on the level of the big ones only there was, as you say, an isomorphism between my model and Bill Thompson's. In fact, my book was fairly complete when I sent a copy of the manuscript to Bill Thompson and he immediately fired back a letter saying, "look here, look there, look on this other page," and so on in his book. I already knew him and had two or three of his books on my shelf, and hadn't really noticed this. But when he called my attention to it I looked back and, yes, indeed, he had anticipated my view of history in almost exactly the same bifurcations and paradigm shifts on the largest level. However, when he saw my book he realized for the first

time I think, that his view of history must be mathematical and on that basis was formed our friendship, which goes on to this day.

He and I are engaged now in an interesting exercise which is a further working out of this mathematical view of cultural history. And that is a new curriculum for elementary schools, grades K through 12.⁹ The major bifurcations in culture history are mapped onto the major bifurcations in psychological development in the sense of Piaget, so that in kindergarten you're in the early Paleolithic culture; and in the first grade you're in the Epipaleolithic; in the second grade, you experience the agricultural revolution; in the third grade comes the wheel, the first cities: Sumer, Egypt, Babylon, Canaan and so on; in the sixth grade you're in ancient Greece; and in the seventh grade comes late antiquity and medieval Islam and so on.

JE: You've also worked with Rupert Sheldrake.¹⁰ Would you say that his morphogenetic fields are similar in any way to attractors, bifurcations and so forth?

RA: Well, his theory is very consistent with chaos theory. Sheldrake has a slightly larger view than any of the views we've discussed so far in our conversation except possibly what I've described as the pre-patriarchal or the Orphic view about the emanations of the stars, the *anima mundi* and so on. Rupert Sheldrake's idea could be seen in this way: that when we have been talking about concordance between mathematical evolution and cultural evolution, Rupert Sheldrake would have put in here a third thing, which is the soul of the world or the morphogenetic field. He would see mathematical evolution and cultural evolution as manifestations of an evolution which is going on in the morphogenetic field. It's a slightly bigger picture than we've talked about and I think it is compatible with Giordano Bruno, Marsilio Ficino and Renaissance hermetical philosophy but his idea also breaks with the perennial philosophy of the *prisci theologi* in that he sees the field as evolving in a coevolutionary process with culture, the human mind, the biosphere, and so on. So that in having this talk, we are giving nutritional support to the growth of the morphogenetic field; and the morphogenetic field is giving a certain guidance to the form of our conversation and the evolution of our thoughts and relationship. All of this

is evolving together. It seems to me that this is an essentially novel and original contribution to our model of the universe by Sheldrake.¹¹

JE: Chaos theory has a lot to do with pattern recognition in the processes of nature. A great deal of Carl Jung's work involved the recognition of patterns structuring processes in the psyche, and he termed these patterns "archetypes of the collective unconscious." Do you see any relationship here between chaos theory and the work of Jung?

RA: Oh, absolutely. For example, myth and ritual — as remnants of archetypal processes in the minds of earlier peoples — can be regarded as the most stable and long lasting mental cycles or trajectories of the historical past, and in dynamical theory we would translate these states into mathematical models, such as these attractors.

Now, mathematics is not everything, there's a lot more to an archetype than simply its mathematical model so I don't want to imply here that understanding the mathematics would complete an understanding of all and everything. The insights of Jung and people of that sort are ultimately transcendent of mathematics.

However, mathematics as we understand it today involves space-time patterns and a space-time pattern is an ordinary pattern that's moving, and therefore a model for a process. There are certain special kinds of process models which can be recognized in processes occurring in nature and even in the collective unconscious, so in terms of Jung's theory we would have to say that the mathematics is suggesting that we look at myths transforming into other myths. In other words, the mythogenetic process itself might be an archetypal object in the collective unconscious, and if we understand these archetypes correctly, then the past and the present are simply stages on the way to the future and the whole thing is an archetype in space-time. So it could be that a development in mathematics would enable us to see more deeply into the collective unconscious.

JE: So you see myths as dynamical models for morphological processes in the psyche as well as in patterns of culture?

RA: Well, the transformation myth is a manifestation of an archetypal process in the psyche, yes. Even within a generation we can see the myth of Jesus Christ for example, being completely transformed, and that

transformation is archetypal, and as a mathematical object it's had many manifestations in the past. Or say, the birth of Christ or the arrival of Mohammed and his vision of the angel Gabriel: these are different manifestations of a special kind of movement, a bifurcation in the collective unconscious, which as a mathematical model is manifest through history many times over. So understanding the process of transformation is possibly a step toward understanding the myth itself.

JE: Do you see the possibility of all the various domains of the sciences ever fusing together into a single internally consistent paradigm?

RA: Well, yes, it's possible. You see, all of the sciences are fine in themselves. What's missing is a general systems theory, a synthesis of the sciences into a single understanding. Over the years, as everybody knows, science has been afflicted by a disease of reductionism that manifests as an actual repression of synthesis. For example, if a scientist or a professor in a university gets too involved in interdisciplinary work, and let's say, makes a bridge between physical astronomy and botany, then his reputation will suffer and he will be punished or dissuaded from continuing in this way. What is necessary to synthesize the sciences in a significant way, to develop a synthetic scientific view that would actually be taught successfully in universities, high schools and elementary schools, is some kind of sea change in the dogma of science which gave more credit to the synthesis function, and therefore encouraged more synthesis. One way that synthesis could regain its prestige is through the acceptance of chaos theory and complexity theory into universities. That hasn't happened yet: universities are still abusing chaos theorists and excluding them.

JE: Speaking in terms, then of synthesis, you've mentioned that you see the Internet as a material manifestation of a synthesis of all the minds on the planet?

RA: A lot of people are really excited about the World Wide Web and a lot of other people are really petrified because of some wild fantasy of child porn or something. This polarization is taking place and so far I'm still optimistic because of its commercial utility, that the Web will persevere. Within it there are many synthetic activities ongoing in which science, philosophy, religion, history and so on are being strung together by amateur intellectuals who

have no restraint. There's no censorship and no pressure for them to abandon what they're doing and so there's a fantastic synthesis of the sciences, of mythology and so on. How long that will continue I don't know, but it looks good. I think we're up to about 30 million browsers participating in the Web and some of the access providers, America Online for example, encourage people to have their own web pages, so there's something like 10 or 20 million people about to put up their own web pages and any idea they think is important will go there and other people can browse it with the aid of these brilliant indexing engines, web crawlers and robots. It still looks to me that the World Wide Web could actually be an occasion for the synthesis of knowledge on a world-wide scale in which minds are not connected so they become one mind exactly, but there's a very strong coupling between all these minds.

JE: You've also mentioned that you're studying the history of Indian philosophy.¹² Is that what you're engaged in now?

RA: Well, this is still for the future. I have projects in which I'm trying to trace the Orphic tradition through the arrival of the Aryans in India carrying the *Rig Veda* and so on. But my latest book is a high-level math text on chaos theory, *Chaos in Discrete Dynamical Systems*.

I'm largely focused on one project now called the *Euclid Project*, which involves many volumes and CD-ROMs. Its aim is to revolutionize the teaching of mathematics in the schools. It would include *The Roots of Euclid* on sacred geometry and a volume on the connection between Euclid and chaos theory, *Euclid's Voyage Into Chaos*.